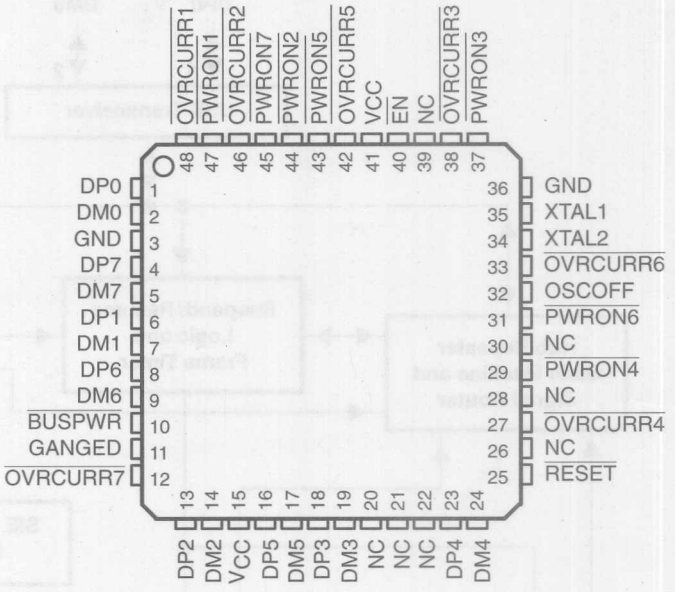
- **Universal Serial Bus (USB) Version 1.0 Compliant**
- **Includes Intel™ Serial Interface Engine (SIE)**
- **Integrated USB Transceivers**
- **Two Power Source Modes**
  - **Self-powered Mode Enables Up to 7 Downstream Ports**
  - **Bus-powered Mode Enables a Maximum of 4 Downstream Ports**
- **Power Switching and Overcurrent Protection is Provided Per Port or Ganged**
- **All Downstream Ports Support Full-Speed and Low-Speed Operations**
- **Supports Suspend and Resume Operations**
- **Available in 48-Pin LQFP Package**
- **3.3-V Operation**
- **48-MHz Crystal Input**

PT PACKAGE
(TOP VIEW)



description

The TUSB2070 hub is a CMOS device that provides up to seven downstream ports in conformance with the USB version 1.0 specification. It supports two power source modes, bus-powered and self-powered. The hub and downstream ports share the same power source mode. When operating on bus-power, only four downstream ports are utilized. Self-powered mode is required when utilizing more than four ports as defined by the USB specification. The TUSB2070 hub powers down to 500 µA during the suspend operation by powering down the internal oscillator.

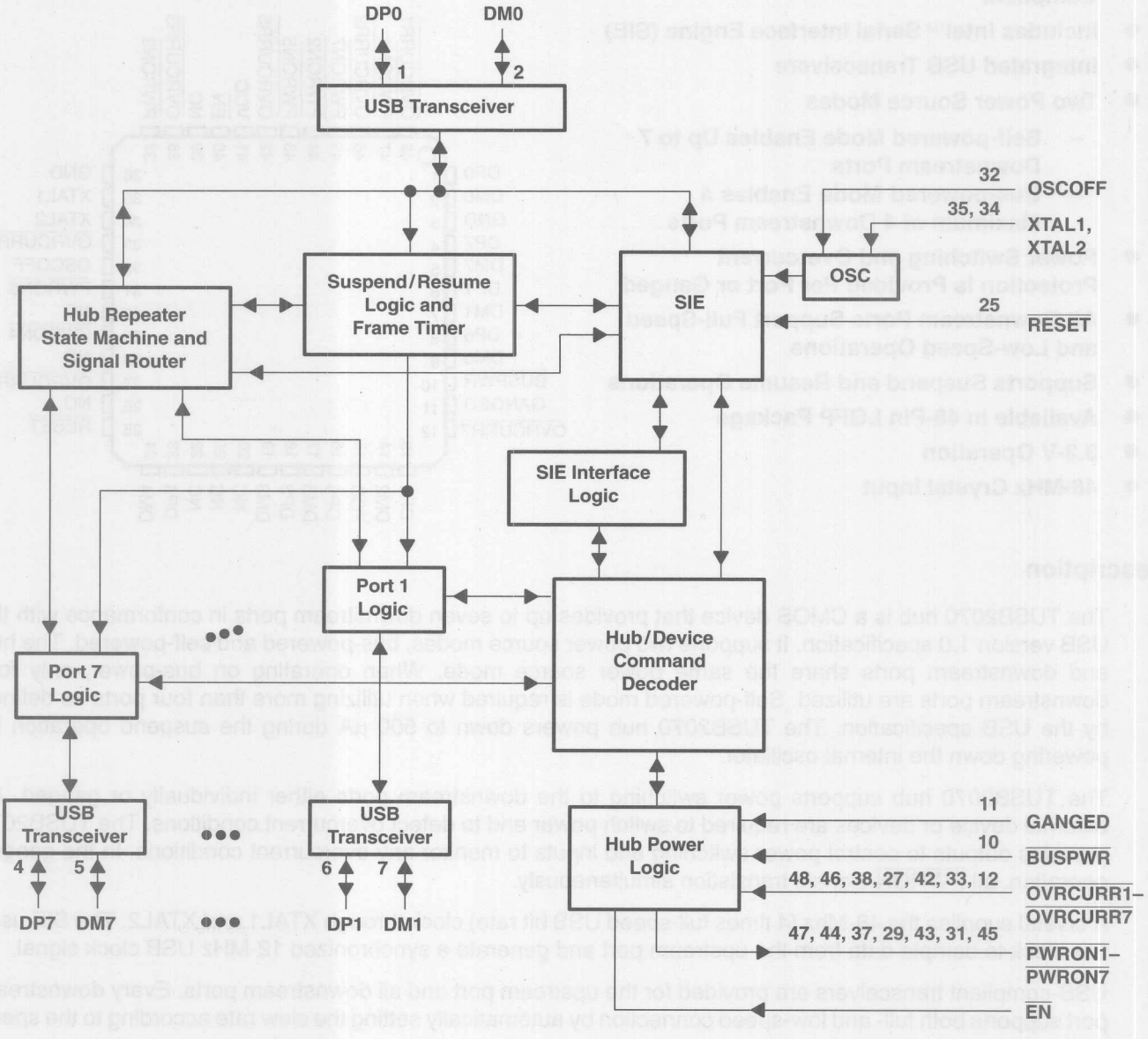
The TUSB2070 hub supports power switching to the downstream ports either individually or ganged. An external device or devices are required to switch power and to detect overcurrent conditions. The TUSB2070 provides outputs to control power switching and inputs to monitor any overcurrent conditions. In the ganged operation, all $\overline{\text{PWRON}}$ signals transistion simultaneously.

A crystal supplies the 48-Mhz (4 times full-speed USB bit rate) clock through XTAL1 and XTAL2. The SIE uses this clock to sample data from the upstream port and generate a synchronized 12-MHz USB clock signal.

USB-compliant transceivers are provided for the upstream port and all downstream ports. Every downstream port supports both full- and low-speed connection by automatically setting the slew rate according to the speed of the device attached to the port.

PRODUCT PREVIEW

functional block diagram



PRODUCT PREVIEW

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Terminal Functions

TERMINAL NAME	TERMINAL NO.	I/O	DESCRIPTION
$\overline{\text{BUSPWR}}$	10	I	Port power indicator. $\overline{\text{BUSPWR}}$ is an active low input that indicates whether the ports and the hub derive power from the bus or are self-powered by the local supply. This standard TTL input must not change dynamically during operation.
DM1–DM7	7, 14, 19, 24, 17, 9, 5	I/O	Data minus USB differential data pairs. DM1–DM7 support up to seven, negative signal, downstream USB ports.
DP1–DP7	6, 13, 18, 23, 16, 8, 4	I/O	Data plus USB differential data pairs. DP1–DP7 support up to seven, positive signal, downstream USB ports.
DM0	2	I/O	Data minus USB differential data. DM0 is used for the upstream USB port cable pair, negative signal.
DP0	1	I/O	Data plus USB differential data. DP0 is used for the upstream USB port cable pair, positive signal.
$\overline{\text{EN}}$	40	I	Enable. $\overline{\text{EN}}$ must be tied low for normal operation.
GANGED	11	I	Power switch/overcurrent detection. GANGED selects between gang or per port switching and overcurrent detection for downstream ports. The setting is dependent upon an external power control device. This standard TTL input must not change dynamically during operation.
GND	3, 36		Ground. All terminals must be tied to ground for proper operation
OSCOFF	32	I	Oscillator off. OSCOFF disables the internal oscillator for quiescent current draw (ICCQ) testing. OSCOFF must be tied low for proper operation.
$\overline{\text{OVRCURR1}}$–$\overline{\text{OVRCURR7}}$	48, 46, 38, 27, 42, 33, 12	I	Overcurrent indicators. $\overline{\text{OVRCURR1}}$–$\overline{\text{OVRCURR7}}$ are active low, standard TTL inputs. One overcurrent indicator is available for each of the seven downstream ports. These inputs are internally gated when port power-switching is ganged. Unused terminals must be tied high.
$\overline{\text{PWRON1}}$–$\overline{\text{PWRON7}}$	47, 44, 37, 29, 43, 31, 45	O	Power-on/-off control switches. $\overline{\text{PWRON1}}$–$\overline{\text{PWRON7}}$ are active low, open-drain outputs. One power on-/-off control switch is used for each of the seven downstream ports. All outputs are switched together when the port power-switching is ganged.
$\overline{\text{RESET}}$	25	I	Reset. $\overline{\text{RESET}}$ is a TTL input with hysteresis and must be asserted at power up for conformance to USB. When $\overline{\text{RESET}}$ is active low it initializes all logic.
V_{CC}	15, 41		3.3-V supply voltage
XTAL1	35	I	Crystal. XTAL1 is a 48-MHz crystal input. Operation at 48-MHz is four times the USB full-speed bit rate of 12-Mbps.
XTAL2	34	O	Crystal. XTAL2 is a 48-MHz crystal output. Operation at 48-MHz is four times the USB full-speed bit rate of 12-Mbps.

APPLICATION INFORMATION

USB design notes

USB is a serial bus interface providing 5-V power and data to peripheral functions (printers, monitors, joysticks, mice, keyboards, and hubs). USB specifies three power modes for functions: Low-power, high-power, and self-powered. Low-power mode functions draw a maximum current of 100 mA from the USB 5-V line. High-power mode functions may draw a maximum current of 500 mA from the USB 5-V line and may only be connected to self-powered hubs. Self-powered mode functions contain their own power supply, but are permitted a maximum current draw of 100 mA from the USB 5-V line for communication purposes. Personal computers (PC) contain the root hub, that are usually self-powered. (A typical application of the TUSB2070 universal serial bus HUB is shown in Figure 1).

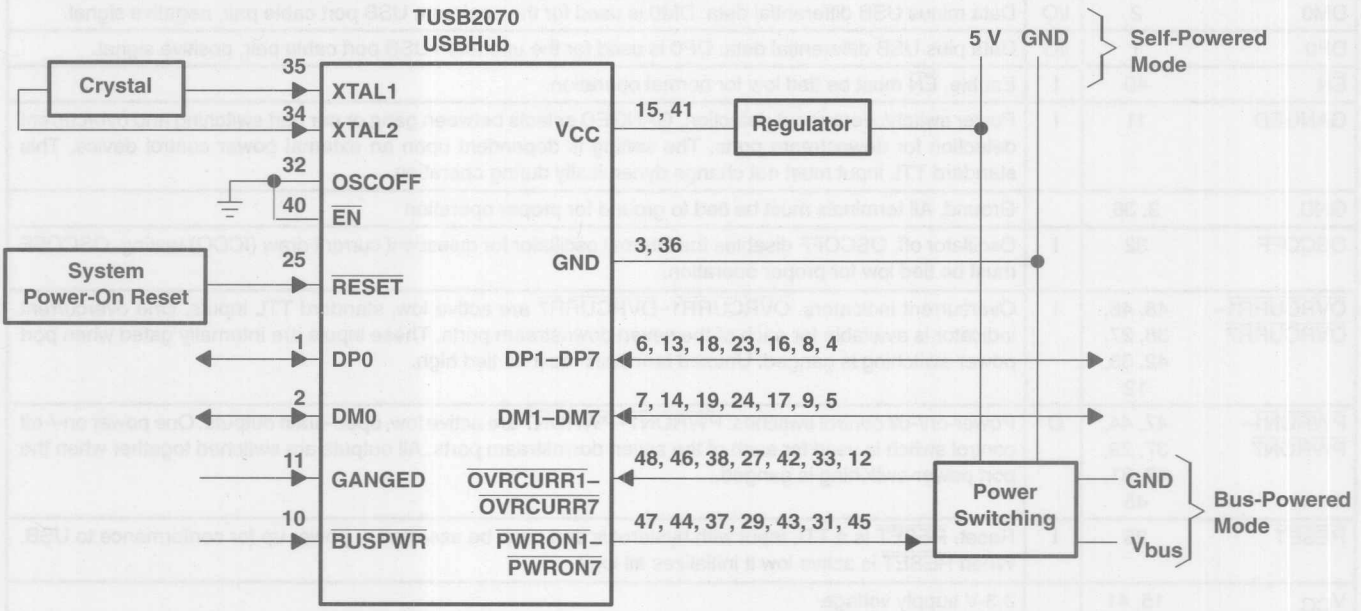

Figure 1. Typical Application of the TUSB2070 USB Hub

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APPLICATION INFORMATION

A major advantage of USB is the ability to connect 127 functions to the bus through a single PC connector (see Figure 2). USB distributes data and power using hubs, which are simply "smart" distributors of data and power, to upstream and downstream ports. Similar to functions, power modes for hubs exist: bus-powered and self-powered. Bus-powered mode hubs draw their power from the USB 5-V line and support only low-powered downstream ports. A bus-powered hub draws a maximum of 500 mA from its upstream port, 100 mA of which is allotted for the hub controller functions. A bus-powered hub should only be connected to a self-powered hub. The root hub of the PC is considered a self-powered hub.

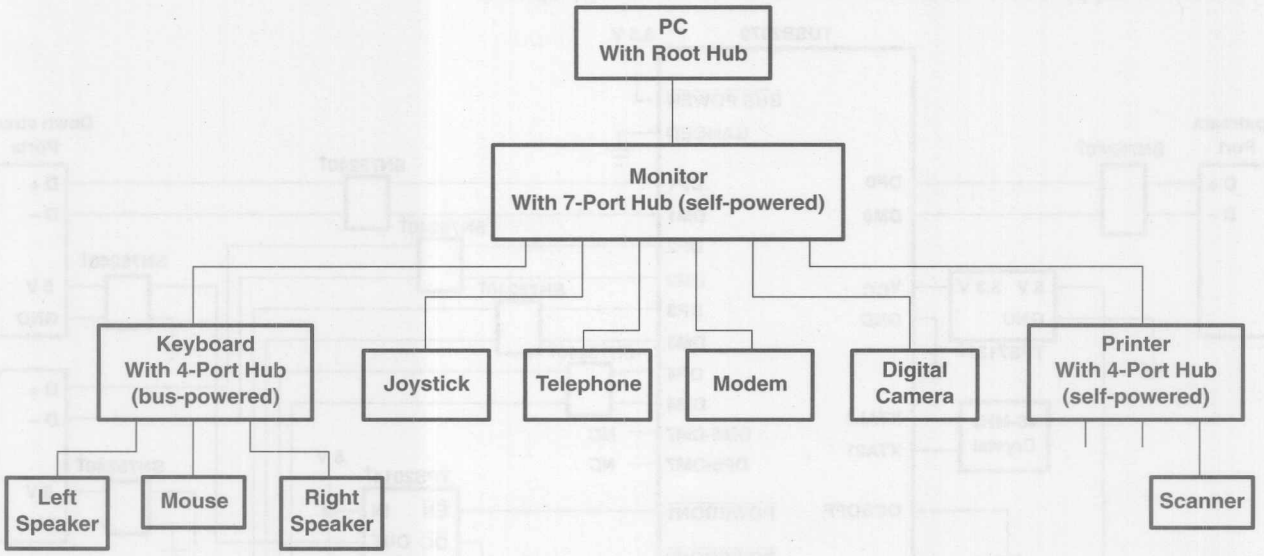


Figure 2. USB Tree Diagram

Self-powered mode hubs require their own power supply and are limited to a maximum current draw of 100 mA from the upstream ports for control functions. Self-powered hubs must be able to supply 500 mA of current to each of its downstream ports. Seven downstream ports are the practical maximum port limit due to power supply constraints.

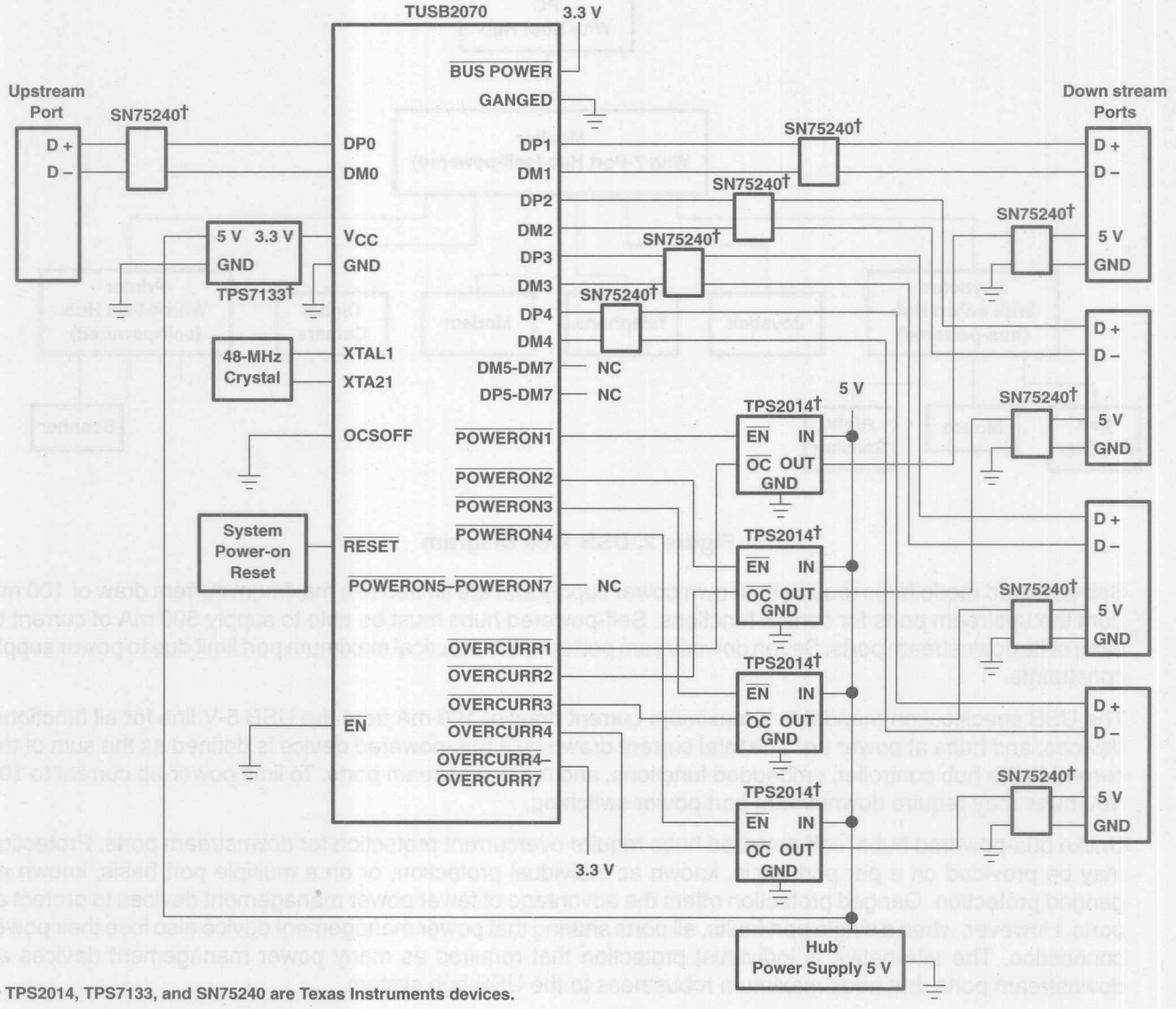
The USB specification mandates a maximum current draw of 100 mA from the USB 5-V line for all functions, devices, and hubs at power up. The total current drawn by a bus-powered device is defined as the sum of the current to the hub controller, embedded functions, and the downstream ports. To limit power-up current to 100 mA, hubs may require downstream port power switching.

Unlike bus-powered hubs, self-powered hubs require overcurrent protection for downstream ports. Protection may be provided on a per port basis, known as individual protection, or on a multiple port basis, known as ganged protection. Ganged protection offers the advantage of fewer power management devices to protect all ports. However, when a single port faults, all ports sharing that power management device also lose their power connection. The alternative is individual protection that requires as many power management devices as downstream ports, but adds maximum robustness to the USB hub system.

APPLICATION INFORMATION

Self-powered hub, individual port protection

A self-powered TUSB2070 supports up to seven downstream ports (four-port operation shown in Figure 3), and is capable of supplying 500 mA of current for low-power or high-power device class functions to each downstream port. The TPS2014 per port power management, power switching, and overcurrent protection provides maximum robustness to the hub system. When the hub detects a downstream port fault, power is removed from the faulty port only, thus allowing other ports to continue normal operation. Individual SN75240 transient suppressors reduce in-rush current and voltage spikes.



† TPS2014, TPS7133, and SN75240 are Texas Instruments devices.

Figure 3. TUSB2070 Self-Powered Hub, Individual-Port Protection Application

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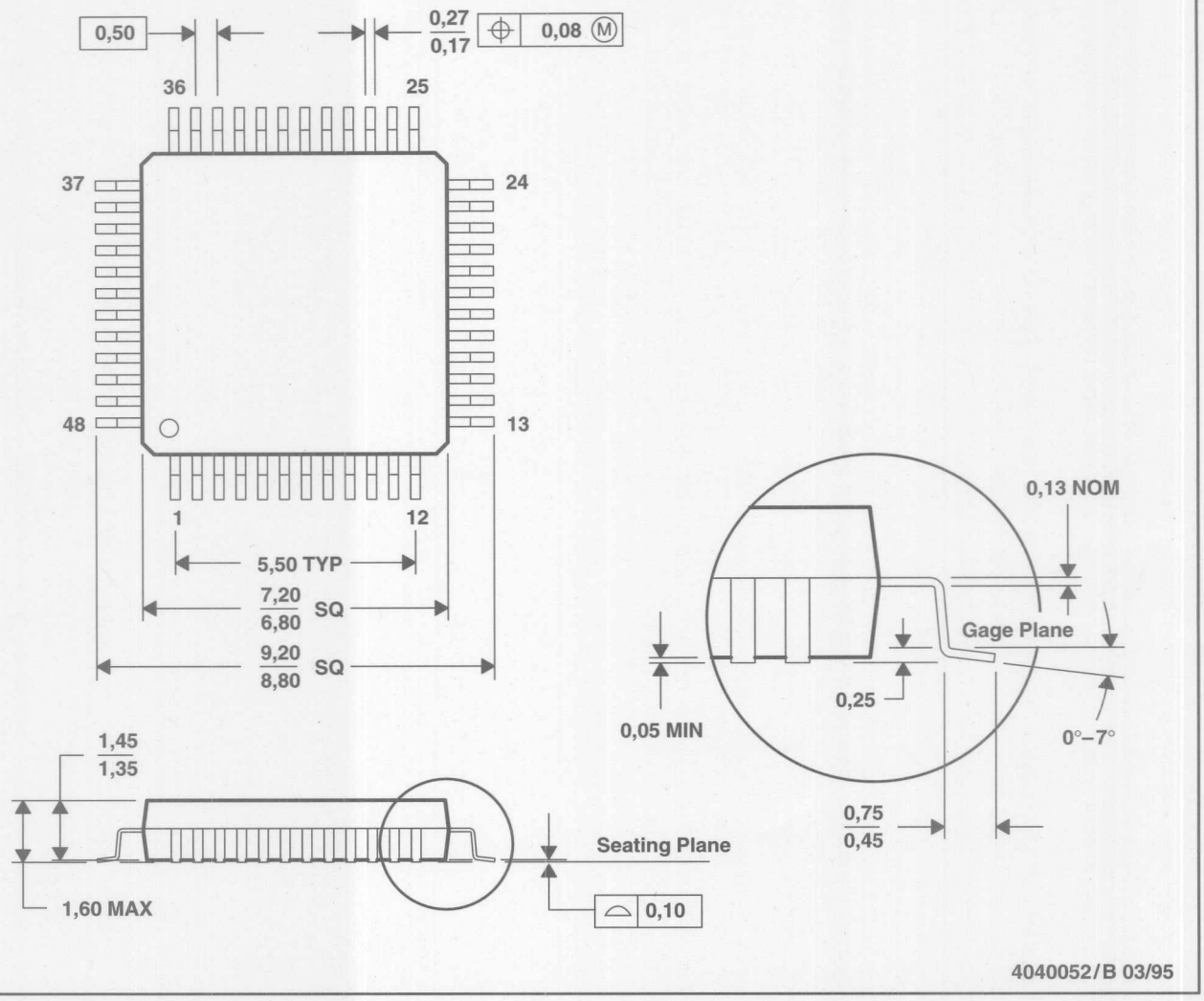
MECHANICAL DATA

PT (S-PQFP-G48) **PLASTIC QUAD FLATPACK**



NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Falls within JEDEC MO-136
D. This may also be a thermally enhanced plastic package with leads conected to the die pads.

PRODUCT PREVIEW

NOTES